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Impacto Ambiental de la Energia
Director

CIEMAT
Departamento de
Impacto Ambiental
de la Energía
SALIDA
Nº 127
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Barrett N.Fountos
Program Manager
Office of International Health Programs
U.S. Department of Energy
1990 1 Germantown Road
Germantown, MD 20874- 1290

Madrid, 31 july 2001

Dear Dr. Fountos:

Please find attached the following documents concerning the INDALO Project:
- Annual Work Proposal for the year 2001.
- Work Performed during 2000. (and attached documents).
- Budget forms (summary sheet, cost statement sheets).
- Copy of the invoice.

Sincerely yours,

José Gutiérrez

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PROJECT INDALO

ANNUAL WORK PROPOSAL FOR THE YEAR 2001

Annual Work Proposal

Office of International Health Programs (EH-63)
U.S. Department of Energy

Project Indalo

Centro de Investigaciones Energeticas Medioambientales y Tecnologicas (CIEMAT)

Purpose: In 2001, we will continue to perform the radiological medical surveillance and environmental monitoring in the area of Palomares (Almería - Spain). In addition it is intended to continue activities included in the recommendations made by the expert panel in its 1998 report, mainly related to soil studies, calculational assessments and risk studies.

Concerning soil contamination, the following tasks will start during 2001:

- to study potential geographical redistribution (wind effect) of the residual contamination, outside the original zero line, checking soils not initially contaminated (Zone 5-3B).
- to identify potential accumulation zones after run-off (SW from impact point 2).
- to check the close surroundings of the impact point 3 (Zone 3) in the opposite direction to the original contamination plume, where hot particles and one contaminated piece have been recently found.
- to estimate americium (Am) inventory in Zone 2-O based on the 1986 core samples already used for the estimation of plutonium (Pu) inventory.

In addition to routine air monitoring, experimental work should be designed considering the simulation of farming practices, trying to correlate the levels of activity in air to farming and meteorological events. This experimental work is considered relevant for assessing risks under hypothetical future scenarios, but it will be very dependent on the acceptance of the parcel owners.

Concerning vegetation studies, emphasis will be put on a historical data review in order to refine risk assessment for the ingestion pathway. Also, data from crops in Zone 5-3B (originally not contaminated), where some evidence of contamination levels in vegetables is being observed, have to be confirmed. If so, a soil-crop correlation study would be planned.

A better statistical significance of Pu and Am content in relevant animal consumption products, such as milk and snails, is required and, therefore, this part of the control program will be enhanced.

Risk assessment will be continued using historical and recent data. The consideration of the evolution of the contaminants, mainly their behavior as hot particles, will be taken into account to determine the influence on inhalation and ingestion pathways and, therefore, in the prediction of the radiological impact along the time on similar scenarios.

Hot particles will be further investigated. The most recent data indicate that the largest part of the contamination inventory could be under this form of particles. Consequently,

effort has to be put in its separation from soil samples and in the determination of its stability and realistic isotopic composition.

The following is a general description of work to be performed.

General Description of Work to be Performed:

I. Concise Statement of Goals

The goals remain unchanged since the signing of the Hall-Otero Agreement. They are:

- To determine the magnitude of the risk of internal contamination in the inhabitants of the zone during the period immediately following the accident and the subsequent emergency phase.

- To assess the short, medium, and long-term risk of internal contamination for those people living in and around Palomares, those who cultivate the contaminated land and those who consume vegetable products grown in this area, as well as products from animals which have been given cereals and other vegetables grown in the area as fodder.

II. Background (includes relevance to DOE programs)

As a consequence of the accident which occurred on January 17, 1966, a radiological medical surveillance and environmental monitoring program has been conducted in Palomares, Spain. This work has been performed pursuant to the Hall-Otero Agreement of February 25, 1966. In Spain, the Centro de Investigaciones Energeticas Medioambientales y Tecnologicas (CIEMAT; Center for Energy, Environmental, and Technological Investigations) is the organization responsible for all technical aspects of this project. CIEMAT provides semi-annual reports to the Spanish Consejo de Seguridad Nuclear (CSN; Nuclear Safety Board), which, in turn, provides summaries of the activities in Palomares to the Spanish Parliament. The CSN is the Spanish organization responsible for radiation protection in general.

III. Methods and Approach

The medical monitoring program consists of clinical examinations and radiobioassays of Pu and Am collected from 24-hour urine samples of 150 residents from Palomares every year. The individuals examined differ each year unless some Pu or Am in urine was detected from the previous year's examination. In addition to these tests, those individuals with the highest potential internal contamination are examined by CIEMAT´s whole body counter. They number approximately 5 to 10 individuals per year. The details of the clinical examinations are on record at DOE. The examinations are performed during the spring and autumn of each year. Approximately 10 individuals are examined each week.

The environmental monitoring program consists of sampling, analysis, and measurements of Pu and Am in air, soil, food crops, wild vegetation, milk, and other products. For example, the air is sampled continuously by high volume samplers equipped with a PM-10 inlet. The filters are changed weekly. There are four air high volume continuous samplers in the area. Soils are sampled with a frequency depending on the characteristics of the experiment to be performed. For example, the frequency of deep soil samples is less than surface soil samples. The frequency of samples in vegetables depends on the growing season and the vegetable species cultivated each year.

Air and urine samples are analyzed by sequential radiochemistry methods for Pu and Am. On separate planchets, Pu and Am are then measured by alpha spectrometry. Other samples, such as soils and vegetation, are analyzed for Pu by radiochemistry and then measured by alpha spectrometry. However, Am is measured directly (in ashes for vegetables and with previous drying and removal of organic matter for soils) by gamma spectrometry without previous radiochemistry. This is now under review for vegetation because the need to improve the detection limit of Am activity, changing the direct gamma spectrometry measurements by radiochemistry and alpha spectrometry at least for the most representative samples. For milk samples, analyses of Pu and Am by sequential radiochemistry methods an then alpha spectrometry measurements are decided. All radioanalyses and measurements are performed according to established procedures at CIEMAT.

The specific sampling, analysis and assessment plan for 2001 is presented below:

Air Samples:

In a optimal way, weekly samples from 4 stations will be collected, (meaning more than 200 samples during the year). However, a lower number of samples is normally obtained due to unexpected stops of the samplers and difficulties for repairing in situ. At this respect, station 2-O is presently out of service because, after continuous failures, a new aspiration pump needs to be purchased, checked and installed. It is expected that the station 2-O will be operative in autumn 2001. During 2001, the samples corresponding to 2000 sampling will be analyzed for Pu (about 100 samples). Also, the remaining samples from 1999 will be analyzed for Am by radiochemistry and measured by alpha spectrometry (about 50 samples). The samples are analyzed individually and accumulated in a monthly basis for measurement. Even in the case that additional experimental work could be planned to study the influence of farming practices in Pu and Am air concentration activities, the experiments are not expected to start until the year 2002.

Vegetation Samples:

The collection and analysis of vegetation will have a low priority during 2001 because an historical review analysis will be performed to identify the best required information for realistic ingestion risk assessment. However a limited number of samples will be collected (about 10) and analyzed (10 for Pu and 5 for Am, always by radiochemistry and alpha spectrometry) with emphasis in those cultivated in

greenhouses placed over previously identified contaminated plots and in Zone 5-3B, outside of the original residual contamination line.

Soil Samples:

Given the fact that hot particles and some contaminated pieces were recently found close around the impact point 3, just on the opposite line (SW) to the original contamination plume (NE), a sampling is planned in this Zone, collecting surface soil samples (approximately 20) over a 50 m SW direction line from the impact point 3. It is also foreseen to progress in the radiochemical analysis of core samples from Zone 2-0, collected to investigate the existence of a burial of wastes, but also useful to follow up the infiltration of the contaminant in depth. Also, a sampling (10 samples and the related Pu analysis) is foreseen in Zone 2-0, in the SW of the impact point of bomb 2, to follow the potential sedimentation of soils removed by water erosion in this Zone and to assess the redistribution of Pu by this reason. In Zone 5-3-B, an initially clean zone, outside the original line zero of contamination, contaminated crops were recently found; this advised for planning soils collection (5 samples) in order to assess the level of the original contamination redistribution by the wind. In total a number of 35 samples is expected to be collected and 25 radiochemical analyses to be performed.

Urine samples:

In total 300 samples will be analyzed for Pu and Am: 150 for Pu and the same 150 for Am by radiochemistry followed by alpha spectrometry.

Snail Samples:

A new snail sampling on different locations will be made in 2001. Also, a sample of cooked snails, ready for consumption, will be obtained from a local snack in order to confirm the relevant significance of such edible animals in the ingestion pathway. The number of samples and analyses will depend on the existence (or abundance) of this type of samples.

Cow and goat milk sampling:

The sampling of goat's and cow's milk will be enhanced to achieve a better statistic and, if possible, to identify seasonal variability. In total 10 milk samples are foreseen during this year; both radionuclides Pu and Am will be analyzed by radiochemistry and alpha spectrometry.

Risk assessment:

Concerning the risk assessment, the initial work done during 2000 will be refined and enlarged using historical and recent data. The objective is to determine if some variability along time can be detected, considering the present scenario. Specifically, the following tasks will be performed:

- To review estimates due to external irradiation in Zone 3, incorporating the measurements on the opposite line (SW) to the original contamination plume (NE), presently in progress.

- To estimate external irradiation in Zone 2.0 based on the Am activity levels in 1986 core samples which are being used for the Am inventory in this zone.
- To correlate historical air concentration measurements with especial events and to estimate the contribution of such type of events to the inhalation doses.
- To refine estimates of doses due to ingestion based on the historical review analysis and the measurements presently in progress and incorporating Am estimates in order to evaluate the significance of its contribution.

The conclusions will be used to improve the risk assessment from the time of the accident and to predict the radiological impact under future similar scenarios.
Also, a structured database containing all the available and useful information will be designed. The collation of historical data for the following aspects will be initiated:

- Geographical location of food production for the food types grown in the area
- Agricultural practices.
- History of agriculture in the area since the accident.
- Age group habits including local food intake rates for example residence times indoors and in the different agricultural tasks.
- Nature and extent of historical remedial actions. Changes in landscape and uses.

These tasks will be also contribute to optimize the resources assigned to experimental tasks, focussing efforts on those aspects that could have higher contribution to the present and future radiological risk.

Hot particles:

In relation to the research on Pu hot particles in soils, the collation of such particles will continue during 2001. Specifically the two following tasks foreseen for 2001in the annual work proposal for 2000 will be performed:
- Characterization of the Pu particles's compounds solubility by sequential leaching techniques.
- Assessment of its isotopic composition by radiochemical methods and verification of the Pu weapon grade's isotopic composition previously evaluated.

IV. Milestones and Deliverables (include dates)

By December 31, 2001, we intend to achieve the following Milestones:

- Perform clinical examinations and radiobioassays of Pu and Am collected from 24-hour urine samples of 150 residents from Palomares.

- Perform sampling, analysis, and measurements of Pu and Am in air, soil, food crops, wild vegetation, milk, and other products. The number of analyses is listed above in Section III.

- Perform risk assessment from the time of the accident and to predict the radiological impact under future similar scenarios.

- Perform separation, identification, characterization and isotopic composition of Pu hot particles in soils.

By April 15, 2001, we will provide the semi-annual progress reports for the first and second halves of 2000. By October 15, 2001, we will provide the semi-annual progress report for the first half of 200 1.

V. Suggested Performance Indicators

- Provide the personal results from clinical examinations and radiobioassays of Pu and Am collected from 24-hour urine samples to the 150 residents from Palomares who were examined during the year, by April 2002.

- Provide the results from the sampling, analysis, and measurements of Pu and Am in air, soil, food crops, wild vegetation, milk, and other samples to CSN by September 2001 (semi-annual report for the first half of 2001) and by March 2002 (semi-annual report for the second half of 2001). These reports will also be provided to DOE. The number of analysis is listed above in Section III.

- Provide results concerning the risk assessment study to CSN and DOE by April 2002.

- Provide results concerning Pu hot particles in soils to CSN and DOE by April 2002.

VI. References

Radiochemical analytical procedures were provided to DOE in 1992. Please see Annex I, Methodologies for Analysis and Measurements in "Summary Report on the Palomares Surveillance Program," July, 1992.

VII. CV's of Investigators (short 1-2 pages, if possible, including only relevant publications for the last 5-1 0 years)

Short CV's of José Gutiérrez, Asunción Espinosa, Antonio Aragón and Javier Martinez were submitted in 1999.

VIII. Budget Request (see attached form)

IX. Addendum Containing Relevant Publication Preprints, etc

- Vigilancia Radiológica en la Zona de Palomares. Informe al Consejo de Seguridad Nuclear (Segundo Semestre del Año 2000) CIEMAT/DIAE/PPRI/51100/2/2001.
- Vigilancia Radiológica en la Zona de Palomares. Informe al Consejo de Seguridad Nuclear (Primer Semestre del Año 2001)
- La presencia de Americio en el suelo de Palomares después de 33 años del accidente y su influencia radiométrica. A. Aragón y A. Espinosa. (V Regional

Congress on Radiation Protection and Safety. Recife, Brasil, April 2001. To be presented)

- Estudio de la contaminación de Plutonio y Americio en un área agrícola. Impacto radiológico ocasionado por consumo de vegetales contaminados. A. Espinosa, A. Aragón y J. Gutitrrez. (V Regional Congress on Radiation Protection and Safety. Recife, Brasil, April 2001. To be presented)
- Tesis doctoral: Comportamiento ambiental de las partículas del combustible nuclear (fundamentalmente plutonio) tras un accidente nuclear en un ecosistema mediterráneo. Autora: A. Espinosa.

X. Other Sources of Funding

No one